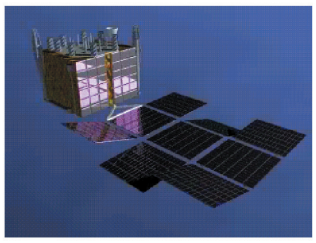
Air Force Research Laboratory|AFRL

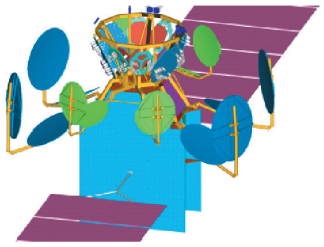
Science and Technology for Tomorrow's Air and Space Force

Success Story

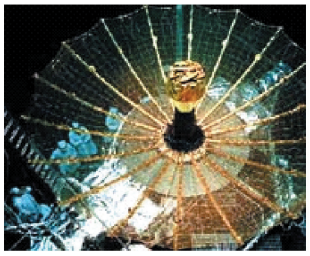
ELASTIC MEMORY COMPOSITE HINGE



Foldout Solar Array
(> 100 W/kg)



*MilSatCom Gen*Star*
(Deployable Antennas)



Space-Based Radar
(Deployable Radar)

Engineers from the Space Vehicles Directorate and Composite Technology Development, Inc. (CTD) of Lafayette, Colorado, have developed technology that has one-fifth the mass, twice the strain capability, and 10 times the damping characteristics of conventional hinge technology. Researchers need large sensor systems and solar panels for space-based surveillance. Due to their size (>10 meters), such systems have deployable structural components. Mechanical deployment systems have up to 75% of their mass at the joints (hinges and latches).

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Accomplishment

Engineers from the directorate and CTD developed elastic memory composite (EMC) hinges. EMC is a fully cured fiber-reinforced composite consisting of traditional fiber reinforcements, such as graphite or glass, and a special "elastic memory" polymer matrix developed by CTD of Boulder, Colorado.

This novel composite can be folded into a very compact shape and deployed in space upon heating. Hinges made with EMC can be used to stow and deploy large sensors in space. A specific thermomechanical cycle provides the ability of EMC materials to achieve, store, and recover relatively high packaging strains.

Researchers induce initial strains by applying a load that forcibly folds the EMC material into the desired, packaged shape while at an elevated temperature above the polymer's glass transition temperature (Tg). Once this has occurred, the packaged EMC material will hold the constrained shape indefinitely. To deploy, the EMC material is again reheated to an elevated temperature above Tg.

Background

The Department of Defense Space Experiments Review Board approved a Space Shuttle flight experiment with EMC hinges to help transition the technology to the satellite primes. The goal of this experiment is to determine the accuracy and the stability of deployment in the space environment. Researchers baselined a 4-meter deployable boom for the FalconSat-3 flight. They are also pursuing insertion into other large deployable experiments such as the Innovative Space-Based Radar Antenna Technology program.

Space Vehicles
Emerging Technologies

Additional information

To receive more information about this or other activities in the Air Force Research Laboratory, contact TECH CONNECT, AFRL/XPTC, (800) 203-6451 and you will be directed to the appropriate laboratory expert. (04-VS-07)